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566.40595X00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	H. TANEI, et al.
Application No.:	09/941,988
Filed:	August 30, 2001
For:	ELECTRONIC COMPONENT AND METHOD OF MANUFACTURING THE SAME
Group:	1775
Examiner:	G. Blackwell Rudisal

RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

September 22, 2003

Sir:

Applicants respectfully traverse the rejection of their claims under 35 USC § 103, as set forth in Item 4 on pages 2-4 of the Office Action mailed May 21, 2003. As will be shown in the following, it is respectfully submitted that all of the claims pending in the above-identified application patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed May 21, 2003, that is, the teachings of the U.S. Patents to Kodera, et al., No. 6,338,893, and to Uchikoba, No. 6,404,318, under the provisions of 35 USC § 103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such an electronic component as in the present claims, including, inter alia, wherein the conductor film is formed using a

conductor paste which does not contain any glass and which contains a silver particle having a specific surface area of $0.3m^2/g$ to $3.0m^2/g$, and, moreover, wherein the firing of the conductor paste, for forming the conductor film, has been performed at a temperature having a difference of $\pm$50°C from a softening temperature of the glass of the ceramic board. See claim 1; note also claim 4.

Furthermore, it is respectfully submitted that the evidence in the original disclosure of the above-identified application establishes unexpectedly better results achieved in solder wettability to the conductor film, and bonding strength of the conductor film to the ceramic board containing glass, using the conductor paste containing silver particles having the specified surface area, and wherein the firing has been performed at a temperature relative to softening temperature of the glass of the glass ceramic board, as in the present claims; and in view thereof clearly establishes patentability of the presently claimed invention. In this regard, it is respectfully submitted that the evidence of record in the above-identified application must be considered in determining patentability of the present invention. See *In re DeBlauwe*, 222 USPQ 191 (CAFC 1984).

The present invention is directed to a glass ceramic board with a silver-based conductor pattern on the surface thereof; and, in particular, is directed to providing such glass ceramic board with conductor film thereon, wherein solder wettability to the conductor film is good, a bonding strength of the conductor film to the glass ceramic board is great and a bond of a gold wire with the conductor film is reliable.

As described in the paragraph bridging pages 1 and 2 of Applicants' specification, where the conductor pattern on the surface of a low temperature co-fired

ceramic multilayer printed circuit board is formed of a silver-based conductor, it is difficult to provide good solder wettability and good bonding strength to the board, while providing a reliable bond with a gold wire. Applicants have found that by utilizing a conductor paste containing silver particles having a specific surface area of $0.3m^2/g$ to $3.0m^2/g$, as the paste for forming the silver-based conductor film, and by firing such paste at a temperature having a difference within 50°C (either greater than or less than) of the softening temperature of glass of the glass ceramic board, the goals of good solder wettability, good bonding strength of the conductor film to the board and reliable bonding with a gold wire are achieved.

That is, as seen in Fig. 2 of Applicants' disclosure, and described in the paragraph bridging pages 9 and 10 of Applicants' specification, the present inventors have found that solder wettability changes in accordance with 1) the temperature difference between the firing temperature and the softening temperature of the borosilicate in the ceramic board, and 2) the particle size of silver particles in the conductor paste. Specifically, it was found out that, when a specific surface area of the silver particle is $0.3m^2/g$ or more, the silver-based conductor film whose ratio of solder diameters after reflow relative to that before reflow, as a percentage, is 95% or more, can be formed by firing with a firing temperature which is different from the softening temperature of the borosilicate by 50°C or less.

Furthermore, as seen in Fig. 3 and the corresponding description in the paragraphs bridging pages 10 and 11, and pages 11 and 12, of Applicants' specification, the present inventors have found by experiments that a tensile strength changes in accordance with the specific surface area of the silver particle in the

conductor paste. If the specific surface area of the silver particle is more than $5m^2/g$, the tensile strength between the ceramic board and a bonding pad formed from the conductor paste is insufficient. Moreover, if the specific surface area of the silver particle is from $0.3m^2/g$ to $3.0m^2/g$, sufficient tensile strength between the ceramic board and the pad is achieved by firing at the firing temperature which is different from the softening temperature of the borosilicate by 50°C or less.

Thus, by utilizing a conductor film formed by firing at the temperature as set forth in the present claims, and by utilizing a conductor film formed from conductor paste with silver particles having the specific surface area as in the present claims, the objectives according to the present invention are achieved. Particularly in view of these objectives unexpectedly achieved according to the present invention, clearly the presently claimed subject matter patentably distinguishes over the teachings of the applied prior art.

While Applicants have previously in the Amendment filed February 14, 2003, in the above-identified application, relied on the evidence in their original disclosure for establishing unexpectedly better results, and therefore unobviousness, of their presently claimed subject matter, the Examiner has not commented on this evidence. It is respectfully submitted that the failure by the Examiner to comment on the evidence is clearly improper. Taking into account the evidence of unobviousness in Applicants' original disclosure, clearly this evidence shows unexpectedly better results achieved as compared with subject matter even closer to the present invention than that of the closest prior art, and clearly establishes unobviousness of the presently claimed

subject matter, even assuming, arguendo, that the teachings of the applied prior art would have established a prima facie case of obviousness.

In any event, if the Examiner maintains the prior art rejection using Kodera, et al. as the primary reference, or for that matter applies any new prior art rejection, it is respectfully submitted that the Examiner must comment on Applicants' evidence.

Kodera, et al. discloses a conductive paste used for a ceramic printed circuit substrate formed of a glass ceramic, and a ceramic printed circuit substrate that uses this conductive paste. The conductive paste includes specific amounts of silver-platinum; manganese dioxide; copper oxide; silicon dioxide having a specific surface area of not less than $50m^2/g$ as measured by a BET method, an average primary grain size of 5-50nm and a purity not lower than 99.8%; and molybdenum and tungsten powder. See column 4, lines 6-14. Note also column 4, lines 15-35, describing advantages of use of the manganese dioxide, silicon dioxide powder, copper oxide, molybdenum and tungsten powder, and absence of glass frit. This patent discloses that the ceramic printed circuit substrate includes an insulation portion formed of glass ceramic containing lead borosilicate glass as a glass component and a circuit portion containing silver as the main component, with at least part of the circuit portion being formed by use of the above-described conductive paste. This patent discloses that simultaneous firing is performed to form the ceramic printed circuit substrate and circuit conductor. See column 4, line 66 to column 5, line 37.

It is noted that Kodera, et al. discloses primarily use of a conductive paste including specified components, the components including, inter alia, silicon dioxide powder. It is respectfully submitted that this reference does not disclose, nor would

have suggested, a conductor film formed by firing the conductor paste which does not contain any glass as in the present claims, and including specific surface area of silver particles of the conductor paste and temperature at which the conductor paste is fired, and advantages achieved thereby as discussed in the foregoing.

In addition, it is emphasized that Kodera, et al. discloses the absence of glass frit, to improve solder wettability, but includes, inter alia, silicon dioxide in the conductive paste. It is respectfully submitted that this disclosure in Kodera, et al. would have neither taught nor would have suggested the conductor film formed by firing a conductor paste, which does not contain any glass, and also contains the silver particles having the specific surface area, with the paste being fired at the specified temperature, as in the present claims.

Again, it is emphasized that the presently claimed subject matter recites that the conductor paste does not contain any glass; in contrast, Kodera, et al. only recites that the paste does not contain glass frit. Moreover, note that Kodera, et al. discloses silicon dioxide, which is a prime component of glass in the conductor paste. It is respectfully submitted that Kodera, et al. does not disclose, nor would have suggested, an electronic component wherein the conductor film is formed by firing a conductor paste which does not contain any glass, much less wherein the conductor film is formed by firing a conductor paste which contains a silver particle having the recited specific surface area and wherein the conductor film has been formed by firing a conductor paste at a temperature having the recited temperature different from a softening temperature of the glass of the ceramic board, as in the present claims.

The Examiner has relied on simultaneous firing in Kodera, et al., of the conductive paste and of the ceramic green sheet "at a temperature not higher than 1000°C.", as a basis for holding obvious the firing temperature of the conductor paste as in the present claims. This reliance for the conclusion of obviousness is respectfully traversed. It is respectfully submitted that this firing temperature not higher than 1000°C would not have disclosed, nor would have suggested, the conductor film having been formed by firing a conductor paste at a temperature having a difference of ±50°C from a softening temperature of the glass of the glass ceramic board, much less this firing temperature with the particle size of the silver particles of the conductor paste, much less the unexpectedly better results achieved thereby, as in the present invention.

The Examiner has pointed to Examples 3-5 of Kodera, et al., particularly Table 1 in columns 7 and 8 thereof, as showing that, even without the use of silicon dioxide, solder wettability is 100%. However, it is respectfully submitted that this result is obtained in Kodera, et al., because solder wettability is improved by use of silver conductor paste without including glass frit, and the initial bonding strength between the board and the silver conductor is improved by adding several oxides and metals to the silver conductor paste without including a glass frit. That is, Kodera, et al. tries to improve solder wettability and the bonding strength between the board and the silver conductor based on an entirely completely different technical idea from that of the present invention.

It is respectfully submitted that the teachings of the secondary reference applied by the Examiner, Uchikoba, et al., would not have rectified the deficiencies of

Kodera, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Uchikoba, et al. discloses a multilayer inductor which has internal conductors, of a main constituent which is silver, at the interior of a substrate composed of a constituent belonging to spinel ferrite for attenuating noise elements. The internal conductors are drawn outside of the substrate, and the drawn portions are provided with external electrodes. Manganese and bismuth are contained in the internal conductors, and the manganese and bismuth contents at an interface between the internal conductors and the substrate are more than those of other ranges. See column 2, lines 5-14. This patent goes on to disclose that the manganese and bismuth are interposed between the internal conductors and spinel ferrite (as the substrate) for moderating stress. See column 2, lines 15-17. This patent goes on to describe, in column 4, lines 4-9, that the conductor paste used includes silver powder of an apparent density of 4 g/cm^3 and a specific surface area of 0.5 m^2/g, MnO_2 and Bi_2O_3.

Initially, it is respectfully submitted that the teachings of Uchikoba, et al. would not have been properly combinable with the teachings of Kodera, et al. It is respectfully submitted that Kodera, et al. is directed to the technology of ceramic printing circuit substrates, while Uchikoba, et al. is directed to a multilayer inductor layer, which are different technologies. In addition, it is respectfully submitted that Kodera, et al. addresses the problems, inter alia, of providing sufficient initial bonding strength, solder wettability and resistance to high temperatures, of the printed circuit; while Uchikoba, et al. is concerned with moderating stress for internal conductors. In

view of the different technologies involved, and different problems addressed, it is respectfully submitted that one of ordinary skill in the art concerned with in Kodera, et al. would not have looked to the teachings of Uchikoba, et al. In other words, it is respectfully submitted that Kodera, et al. and Uchikoba, et al. are from non-analogous arts, and that one concerned with the subject matter for Kodera, et al. would not have looked to the teachings of Uchikoba, et al.

Furthermore, it is again noted that Uchikoba, et al. is concerned with moderating stress of internal conductors. It is respectfully submitted that this problem addressed by Uchikoba, et al. is not sufficiently related to problems addressed by the present invention, such that one of ordinary skill in the art would have looked to the teachings of Uchikoba, et al. For this reason also, it is respectfully submitted that Uchikoba, et al. constitutes non-analogous art with respect to the teachings of Kodera, et al., as well as in connection with the present invention.

The contention by the Examiner that the inventions of Kodera, et al. and of Uchikoba, et al. "are related in that each are to electrical components that utilize a silver conductive paste without the use of a glass frit" (see the last paragraph on page 3 of the Office Action mailed May 21, 2003) is noted. However, clearly these two references are directed to different technological areas, and address different problems; and, clearly, as set forth in the foregoing, the problem addressed by Uchikoba, et al. would not have been reasonably related to the problem addressed by the present invention. Thus, clearly the Examiner has not established that one of ordinary skill in the art would have looked to the teachings of Uchikoba, et al.

In any event, it is respectfully submitted that the Examiner has not established proper motivation for combining the teachings of Kodera, et al. and of Uchikoba, et al. It is respectfully submitted that even assuming, arguendo, that the Examiner is correct in that both Kodera, et al. and Uchikoba, et al. use a silver conductive paste without the use of glass frit, this does not provide sufficient basis for combining the teachings of Kodera, et al. and of Uchikoba, et al. as applied by the Examiner particularly in light of the different technologies involved and problems addressed.

Even assuming, arguendo, that the teachings of Kodera, et al. and of Uchikoba, et al. were properly combinable, such combined teachings would have neither disclosed nor would have suggested the present invention, including, in particular, wherein the conductor film has been formed from a conductor paste containing silver particles having a specific surface area of 0.3 m^2/g to 3.0 m^2/g, and the conductor paste has been fired at a temperature having a difference of $\pm$50°C from a softening temperature of the glass of the glass ceramic board. It is respectfully submitted that the Examiner clearly errs in the conclusion that because the green sheets and the printed circuits can be printed at the same time, this satisfies the temperature difference recitation between the firing temperature of the conductor paste and the softening temperature of the glass in the substrate.

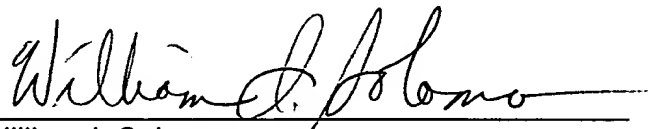
In view of the foregoing, reconsideration and allowance of all claims presently in the application, are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR § 1.136. Please charge any shortage in fees due in connection with the filing of

this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Case No. 566.40595X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



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